REMARKS

Claims 1-4 have been cancelled. New claims 5- have been added. No new matter has been added No claims have been amended or cancelled, and no new claims have been added. Claims 5- are pending.

In conjunction with the undersigned taking responsibility for this application, considerable effort has been made to overcome pre-existing informalities and shortcomings. Unfortunately, this results in some extra effort for the Examiner. The undersigned wishes to apologize for this, and has endeavored to attend to all details and relieve the Examiner of burdens whenever possible.

Disclaimers Relating to Claim Interpretation and Prosecution History Estoppel

Claims 1-4 have been canceled, notwithstanding the belief that these claims were allowable. Except as specifically admitted below, no claim elements have been narrowed

Any reference herein to "the invention" is intended to refer to the specific claim or claims being addressed herein. The claims of this application are intended to stand on their own and are not to be read in light of the prosecution history of any related or unrelated patent or patent application. Furthermore, no arguments in any prosecution history relate to any claim in this application, except for arguments specifically directed to the claim.

Information Disclosure Statements

The Examiner is thanked for considering the IDSes.

Drawings

The Examiner objected to Figures 1-5 as informal. Substitute formal drawings are enclosed.

Specification

The Examiner objected to the specification due to informalities:

- On page 1, line 2 of the *Background of the Invention* section, the Examiner was confused by the phrase "a switching fabric which sends switches the data".

- On page 2, line 1 of the *Summary of the Invention* section, the word "a" is needed between the words "provide" and "switching".

- On page 4, paragraph 2, line 2, there is a space needed in "500includes".

The undersigned thanks the Examiner for his careful reading of the specification, and apologizes for the inconvenience of dealing with these kinds of unnecessary problems. These informalities have been corrected, as have others which the undersigned identified while preparing the substitute specification.

Claim Objections

The Examiner objected to claim 1 -- "a said ring". This objection is respectfully traversed, and is moot in view of the cancellation of claim 1.

Claim Rejections - 35 USC § 112

The Examiner rejected claims 1-4 under 35 USC § 112, second paragraph as indefinite. This rejection is respectfully traversed. Though claims 1-4 have been canceled, the Examiner's concerns have been considered in the new claims with the sincere effort to avoid further § 112 issues.

Claim Rejections - 35 USC § 102

The Examiner rejected claims 1-2 under 35 USC § 102(b) as anticipated by Brewer et al. (USP 5,859,975). This rejection is respectfully traversed.

Brewer is directed to a shared multiprocessing system with several nodes. The nodes are interconnected together for communication purposes by a dual channeled crossbar switch. Several such multichannel crossbar switches can be linked together to form a large cohesive processing system where processing units from one node can access memory from another node on the same

crossbar or from another node on a different crossbar. The interconnection between crossbars is accomplished by a circular ring. The crossbar switches have ports.

Claim 5 recites, "the ring for passing the messages received at the input ports through any respective intermediate data ports to designated output ports", and "a crossbar for switching the frames from the input ports to the output ports". Claim 5 further recites that "the frames consist of relatively long strings of bytes and the messages consist of small entities". Thus, it can be seen that messages and frames in claim 5 are different, and they are handled differently. Packets, which are larger, are switched by the crossbar. Messages, which are smaller, are passed around the ring. Brewer has no disclosure, teaching or suggestion of passing *messages* around a ring and switching *frames*. Instead, Brewer treats all data identically. Thus, Brewer does not disclose, teach or suggest the switching apparatus of claim 5.

This difference also underlies why Brewer does not disclose the additional feature of claim 6. Claim 6 recites "a parser for separating the frames from the messages to form two separate data streams." The Examiner correctly stated that Brewer's dual crossbar switch 11 separates requests from responses. Yet, Brewer's separation is not the same as a separation of "frames" and "messages".

In sum, Brewer does not anticipate claims 5 or 6.

Claim Rejections - 35 USC § 103

The Examiner rejected claims 3-4 under 35 USC § 103 as obvious from Brewer in view of Szcepanek et al. (USP 6,621,818). This rejection is respectfully traversed. Szcepanek does not alone or in combination with Brewer resolve the differences between claim 5 and Brewer. Since claim 5 is allowable over these references, so are the dependent claims.

Claim 7 recites, "a clock for moving the messages by one data port for every clock pulse." The Examiner correctly states that Szcepanek discloses a clock, and that it would be obvious to use a clock in Brewer. However, it is not correct to say that it would be obvious to use Szcepanek's clock

in the manner claimed – "for moving the messages by one data port for every clock pulse." Neither Szcepanek nor Brewer disclose, teach or suggest this feature.

Claim 8 recites, "plural gates respectively associated with each data port for allowing a given message into a given data port only if no other data is present in the given data port." According to the Examiner, Szcepanek discloses this feature at column 15, lines 1-9. Yet, that portion of Szcepanek is directed to check the status of a control line, not to whether a data port has "no other data".

In sum, Brewer in combination with Szcepanek does not render obvious claims 7 or 8.

Conclusion

It is submitted, however, that the independent and dependent claims include other significant and substantial recitations which are not disclosed in the cited references. Thus, the claims are also patentable for additional reasons. However, for economy the additional grounds for patentability are not set forth here.

In view of all of the above, it is respectfully submitted that the present application is now in condition for allowance. Reconsideration and reexamination are respectfully requested and allowance at an early date is solicited.

The Examiner is invited to call the undersigned attorney to answer any questions or to discuss steps necessary for placing the application in condition for allowance.

Respectfully submitted,

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MESSAGE RING IN A SWITCHING NETWORK

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RELATED APPLICATION INFORMATION

[0002] This patent is related to Application No. 09/971,097 entitled "Switching Apparatus For High Speed Channels Using Multiple Parallel Lower Speed Channels While Maintaining Data Rates" and filed 10-3-2001.

BACKGROUND OF THE INVENTION

[0003] **Field of the Invention** ~~Introduction~~

[0004] The present application is directed to a switching network for receiving and transmitting data packets having both frames and messages which utilizes a ring for messages and an associated crossbar switch for frames.

[0005] **Description of the Related Art** ~~Background Of The Invention~~

[0006] In a switching network, all receiving channels (or ports) route data to a switching fabric. The switching fabric sends the data to a specific destination port.~~, which sends switches the data, which~~ The data is normally in the form of data packets either of uniform or variable length~~, to a specific destination port~~. A data packet may include both frames which consist of relatively long strings of data bytes for example 40 to 64 bytes and larger, and ~~also include~~ messages which consist of small entities of, for example 4, 8, or 12 bytes. Such small entity messages might include formats of broadcast flow control, back pressure/feed forward messages, linked table configuration, write or read formats and other similar formats. Input ports are connected to output ports by a well known crossbar connection matrix. Such crossbar matrices typically reside on a die where there may be 64 ports and each port has a data bus of 16 signal lines. Thus, with a total of 2,048 signal lines, the crossbar switches are silicon resource intensive. In other words, to efficiently utilize this silicon resource (that is the silicon die on which the crossbar switch is integrated), it is very inefficient to transmit small entity messages (that is 4, 8, or 12 bytes, for example, as discussed above) through the crossbar switch. It is more efficient, rather, to transmit frame size packet portions which range from 40 to 64 bytes and greater.

[0007] Ring networks have also been suggested for data transfer. See IEEE 802.5 standard. However, this is used in a computer network where a computer must first catch a token and then attach a "message" to it.

~~OBJECT AND SUMMARY OF THE INVENTION~~

~~It is a general object of the present invention to provide switching network using a message ring to receive and transmit messages.~~

~~In accordance with the above object, there is provided a switching network for receiving and transmitting data packets having both frames which consist of relatively long strings of bytes of, for example, 40 to 64 bytes, and messages which consist of small entities of, for example 4, 8, 12 bytes comprising a ring of data ports. Crossbar means connect the ports for switching the frames from an input port to an output port. Ring means successively interconnect one port to an adjacent port in the ring for forming the ring for passing the messages from an input port, successively through intermediate ports to a destination output port. The frames and messages are processed simultaneously.~~

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a is a simplified block diagram of switching apparatus embodying the present invention.

[0009] FIG. 2 is a circuit schematic of message ring architecture embodying the present invention.

[0010] FIG. 3 is a block diagram illustrating the operation of FIG. 2.

[0011] FIG. 4 is a circuit schematic illustrating the operation of FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

[0012] FIG. 1 is an overall diagram of a switching apparatus which includes as an essential component the switching network of the present invention. Specifically, there are 8 switch elements designated SE0 through SE7. Each of these switch elements have 64 input and 64 output lines. There are equivalent numbers of switching networks in each of the switching elements. The overall switching apparatus in FIG. 1 is also disclosed in ~~a~~ co-pending ~~application entitled "Switching Apparatus For High Speed Channels Using Multiple Parallel Lower Speed Channels While Maintaining Data Rates" Filed Oct. 3, 2001, U.S. Ser.~~ Application No. 09/971,097 ~~(Attorney Docket No. 6979/13)~~.

[0013] Referring in general to the operation of the switching apparatus of FIG. 1, there are a number of ingress source ports 11 numbered 0 through 63, each receiving data packets from, for example, a framer which normally puts together such packet, at a rate of 10 Gbps. The ingress ports 11 include a TM (traffic manager) and a communications processor (CP) and are labeled CP/TM. Each ingress source port has an 8-line output port, each individually coupled to an input port of switch elements SE0 through SE7 which together create a so-called switching fabric. In turn, the eight switch elements each with 64 input ports and 64 output ports are similarly connected on an output side to egress ports 12 also designated CP/TM which have 8-line inputs and are numbered 0 through 63. The combination of the 64 ingress ports and 64 egress ports make up a 64 port full duplex port.

[0014] Again, as on the input side, each output port of a switch element has a direct serial link to one of the CP/TMs or egress port units. Then the egress ports 12 are coupled into, for example, a high speed channel network (e.g., fiber optic) to transmit data at a 10 Gbps rate in

a manner similar to the incoming data, but with the data having been rerouted to a selected destination port. Finally, as indicated in FIG. 1, the high input and output data rates of 10 Gbps cannot normally be sustained separately by the switch elements SE0 through SE7 which as indicated are limited to a lower data rate of 2.5 Gbps.

[0015] FIG. 2 illustrates a combined crossbar switch 510 with a message ring 550 having a number of input ports nominally designated 500a through 500h. From a practical standpoint, in the context of the present invention, there is one input port (and one output port) for each of the 64 lines shown in, for example, switching element SE0 in FIG. 1. Thus, the circuit of FIG. 2 is an integrated portion of each of the switching elements SE0 and SE7 of FIG. 1. Each port may either be a source, that is input, or destination port depending on the nature and the location of the switching element. The switching network of FIG. 2 forms a typical crossbar switch (as discussed above) where the internal crossbar switch unit 510 receives from the various input ports 500a through 500h, data streams from the various communications processors/traffic managers 0 through 63 illustrated in FIG. 1.

[0016] Referring briefly to FIG. 3, each port of the switching network of FIG. 2, is associated with a parser/FIFO illustrated in dash outline 20 in FIG. 2 and shown in greater detail in FIG. 3. On line 21, data packets are routed to or from a CP/TM at a 2.5 Gbps rate. A parser 22 identifies whether the portion of the data packet is a message or frame and then respectively sends it to a frame FIFO 23 or a message FIFO 24 (FIFO being an abbreviation for First In First Out memory). Then, on the input/output lines 26, 27 of the respective FIFOs, the frame or message data is input to a port or node 500a-500h (one of the 64 ports) and processed or switched as determined by the ring controller 520 and the clock 560.

[0017] If a frame is being routed to a desired destination port, the crossbar switch 510 operates in a normal manner where, for example, data would be input into the node 500h, directly switched to the crossbar switch 510, and then immediately switched to the desired destination port. As discussed above, to perform this switching with a small entity message would be both inefficient and unduly congest the crossbar switch. Thus, if a message that is in place or queued up in message FIFO 24 as illustrated in FIG. 3, it is inserted in a particular node or port (assuming the port has no other data present in it at the moment) and then passed successively through intermediate ports via the interconnecting lines 600 between ports until the final destination port is reached. Thus, the interconnecting lines 600 between the ports 500a-500h form the message ring 550. Under the control of clock 560, messages are moved from one available port to the next for every clock pulse.

[0018] In order to avoid conflict with the crossbar switch, however, each port 500a-500h~~H~~ includes, as illustrated in FIG. 4, a gate 31 (nominally of the AND type) which buffers a data input 32 to an output register 33 which is connected to, for example, a port 500h under the control of line 34 from the controller 520. This prevents conflict with the simultaneous crossbar switching of the same switching network as illustrated in FIG. 2.

[0019] FIG. 5 is a flow chart illustrating the operation of FIGS. 3, 4 and 5. In ~~the~~ step 200 a data packet is analyzed by the parser 22 and it is determined whether it is a message or frame.

[0020] Then in step 210, if it~~'s~~ is a frame, it is routed in the conventional manner through the crossbar switch as discussed above. If a message is placed in a message in queue in step 220 (as also illustrated in FIG. 3) it is handled in a first in, first out (FIFO) manner.

[0021] In step 230 the message is inserted into one of the ports or nodes of the message ring, that is 500a-500h, and is also given a message ring destination identifier in step 240. It is passed from port to port in step 250 under the control of the clock 560 and the gate unit of FIG. 4.

[0022] In step 260 the question is asked if the message is at its destination port. If no, it is passed to the next port in step 270 but if yes as indicated in FIG. 5, it is placed in a message out queue in step 280. And as illustrated in FIG. 3, the message out queue is a message FIFO which is operating in an output manner.

[0023] Thus, messages do not pass through the crossbar 510 as illustrated in FIG. 3 but instead they are passed directly through the message ring from port to port. Thus, congestion of the crossbar switch is minimized.

[0024] In summary, a switching network for receiving and transmitting data packets having both frames and messages is provided by the use of a message ring.

[0025] **Closing Comments**

[0026] The foregoing is merely illustrative and not limiting, having been presented by way of example only. Although exemplary embodiments of the invention have been shown and described, it will be apparent to those having ordinary skill in the art that changes, modifications, and/or alterations may be made, none of which depart from the spirit of the present invention. All such changes, modifications and alterations should therefore be seen as within the scope of the present invention.

[0027] Although many of the examples presented herein involve specific combinations of method acts or system elements, it should be understood that those acts and those elements

may be combined in other ways to accomplish the same objectives. With regard to flowcharts, additional and fewer steps may be taken, and the steps as shown may be combined or further refined to achieve the methods described herein. Acts, elements and features discussed only in connection with one embodiment are not intended to be excluded from a similar role in other embodiments.

[0028] For any means-plus-function limitations recited in the claims, the means are not intended to be limited to the means disclosed herein for performing the recited function, but are intended to cover in scope any means, known now or later developed, for performing the recited function.

[0029] As used herein, "plurality" means two or more.

[0030] As used herein, a "set" of items may include one or more of such items.

[0031] As used herein, whether in the written description or the claims, the terms "comprising", "including", "carrying", "having", "containing", "involving", and the like are to be understood to be open-ended, i.e., to mean including but not limited to. Only the transitional phrases "consisting of" and "consisting essentially of", respectively, are closed or semi-closed transitional phrases with respect to claims.

[0032] Use of ordinal terms such as "first", "second", "third", etc., in the claims to modify a claim element does not by itself connote any priority, precedence, or order of one claim element over another or the temporal order in which acts of a method are performed, but are used merely as labels to distinguish one claim element having a certain name from another element having a same name (but for use of the ordinal term) to distinguish the claim elements.

[0033] As used herein, "and/or" means that the listed items are alternatives, but the alternatives also include any combination of the listed items.

CLAIMS

It is claimed:

1. A switching network for receiving and transmitting data packets having both frames which consist of relatively long strings of bytes of for example 40 to 64 bytes and messages which consist of small entities of for example 4,8,12 bytes comprising: a ring of data ports: crossbar means for connecting said ports for switching said frames from an input port to an output port: means for successively interconnecting one port to an adjacent port in said ring for forming a said ring for passing said messages from an input port, successively through intermediate ports to a destination output port, said frames and messages being processed simultaneously.

2. A switching network as in claim 1 including parser means for separating said frames from said messages to form two separate data streams.

3. A switching network as in claim 1 including clock means for moving said messages one port for every clock pulse.

4. A switching network as in claim 1 including gate means associated with each said port for allowing a message into a port only if no other data is present in said port.

ABSTRACT OF THE DISCLOSURE

There is disclosed a~~A~~ switching network for efficiently receiving and transmitting data packets having both frames and messages. The switching network includes a crossbar switch with a plurality of surrounding ports for exclusively switching frames which normally consist of large data streams of 40 to 60 bytes. Then the ports are connected together in a message ring and small data entity messages, for example 4, 8, or 12 bytes, are switched from an input port to an output port around the ring avoiding congestion of the crossbar switch.